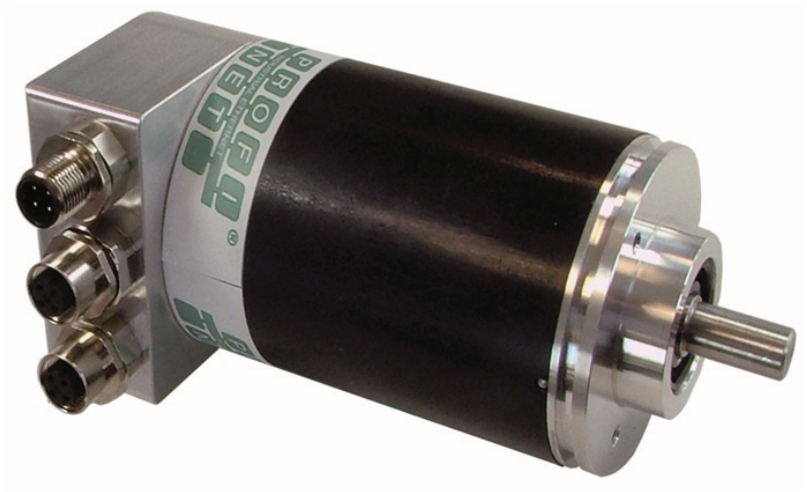
TWK ELEKTRONIK

CRT absolute encoders with PROFINET interface
Relevant data sheet CRT 11889

Data sheet no.: CRT 11890 CE
Date: 03.04.2012



User manual

TWK-ELEKTRONIK GmbH
Heinrichstrasse 85
D-40041 Düsseldorf
Postbox 10 50 63
Tel. +49 211 96117-0
Fax +49 211 637705
info@twk.de
www.twk.de

POB 10 50 63 ■ 40041 Düsseldorf ■ Germany
Tel. +49/211/63 20 67 ■ Fax +49/211/63 77 05
info@twk.de ■ www.twk.de

Table of contents

1. Safety instructions 5
1.1 Scope 5
1.2 Documentation 5
1.3 Proper use 5
1.4 Commissioning 5

2. General information 6

3. Installation 7
3.1 General information 7
3.2 Electrical connection 7
3.3 Status LEDs 8
3.4 Project planning 8

4. Project planning with Simatic Step7 9
4.1 Prerequisites 9
4.2 Installation of the GSD file 9
4.3 Installing the absolute encoder 10
4.4 Installing the module 11
4.5 Setting the network data (CRT properties) 13
4.6 Setting the absolute encoder (properties of the module) 14
4.6.1 Setting the I/O address 14
4.6.2 Parameterising the absolute encoder 14
4.7 Setting real time mode and the updating time 15
4.8 Planning of "Device exchange without programming device" and "Automatic commissioning" 15
4.9 Assignment of the device name 16
4.10 Resetting to the default settings 17
4.11 Application programme 18
4.11.1 Position value and preset 18
4.11.2 Reading diagnostic data 19
4.11.3 Writing parameters 21

5. Data format 23
5.1 Module "Class2, xx bit" 23
5.2 Module "Class2, position (xx bit) + velocity" 23
5.3 Position data 23
5.4 Velocity 23
5.5 Setting the reference value (preset value) 24

Table of contents

6. Parameterisation 25
6.1 Overview 25
6.2 Description of the absolute encoder parameters 25

7. Diagnosis 27
7.1 Overview 27
7.2 Diagnostic data 27
7.3 Manufacturer-specific diagnostic data 28

8. Scope of delivery 29

Annex A: absolute encoder terms 29

1. Safety instructions

1.1 Scope

This user manual is valid exclusively for the following absolute encoders with PROFINET interface:

- CRTxx-xxxxRxxxxC4M01

1.2 Documentation

The following documents must be observed:

- The owner's system-specific operating instructions
- This user manual
- Data sheet number CRT 11889
- The connection assignment enclosed with the device
- Assembly instructions TZY10206 enclosed with the device

1.3 Proper use

The TWK-ELEKTRONIK GmbH absolute encoders and linear transducers are used to register angular or linear positions and make their measured value available in the form of an electrical output signal. As part of a system, they have to be connected to the downstream electronics and must only be used for this purpose.

1.4 Commissioning

- The relevant device may only be set up and operated in combination with this and the documentation specified under point 1.2.
- Protect the device against mechanical damage during installation and operation.
- Device commissioning and operation may only be undertaken by a specialist electrician.
- Do not operate the device outside of the limit values specified in the data sheet.
- Check all electrical connections before commissioning the system.

2. General information

The CRT optoelectronic absolute encoders are designed for direct connection to the industrial Ethernet system PROFINET. The profinet interface according to IEC 61158 / 61784 or PNO specifications Order Nos. 2.712 and 2.722 version 2.3 is integrated.

The specifications can be obtained from the profibus user organisation (www.profibus.com).

The CRT PROFINET absolute encoder offers the class 2 encoder profile familiar from the CRD profibus absolute encoder. In terms of setting the reference value, parameterisation and diagnosis, handling is therefore identical for the user.

From firmware version 2.0 onwards the encoder supports a 16 bit velocity signal in the dimension steps/gating time in addition to the position value. The gating time is adjustable in the range of 10…10000 ms.

3. Installation

3.1 General information

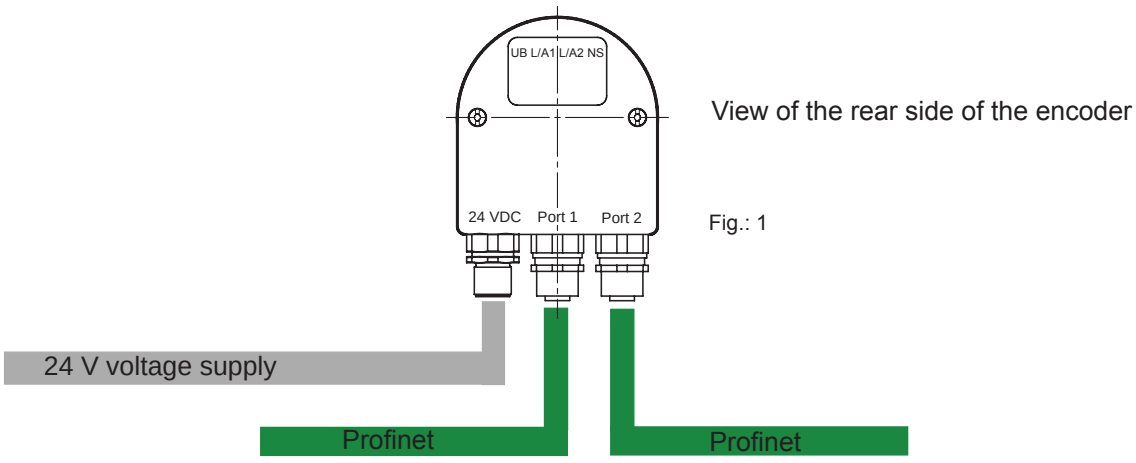
- During installation, observe the profinet assembly guideline PNO order No.: 8.071
- Use only certified profinet cables, connectors and switches (see "PROFINET Cabling and Interconnection Technology" PNO order No.: 2.252 and "Installation Guideline PROFINET Part 2: Network Components" PNO order No.: 2.252 p2)
- Hubs are not permissible.
- The cable length between two subscribers may be max. 100 m.
- The TWK CRT absolute encoder possesses an integrated switch. This not only enables tree and star topologies but also the linear topology.
- Media redundancy protocol support enables the establishment of a redundant ring.
- The setting of addresses, the baud rate or terminating resistors on the device is not necessary.

3.2 Electrical connection

The " ...M01" type absolute encoders have separate connectors for the supply and the PROFINET system. Port 1 or port 2 are optionally available for the PROFINET connection. Due to the integrated switch, it is irrelevant which port is used.

Connection	Designation	Connector type
PROFINET	Port 1	M12x4 D-coded socket
PROFINET	Port 2	M12x4 D-coded socket
Voltage supply	24 VDC	M12x4 A-coded pins

Refer to data sheet No. 11889 for connector assignment and ordering information.



View of the rear side of the encoder

Fig.: 1

3.3 Status LEDs

Four LEDs are housed in the absolute encoder's connecting cap. These have the following meaning:

UB (VB)	Link1 (L/A1)	Link2 (L/A2)	Status (NS)	Description
grün	grün	grün	grün/rot	
on				Operating voltage available
	on			Network connection established
		on		Network connection established
			Green	Data exchange, device in operation and OK
			Red, slow flashing (1 Hz)	Firmware download mode
			Red flashing (2 Hz)	Impermissible parameter or preset value
			Fast red flashing (10 Hz)	System error or wrong module
			Red	Connection to the PROFINET controller disrupted

3.4 Project planning

A device description file (GSD file) in the XML format GSDML and an image (bitmap) to integrate the absolute encoder into a project planning tool are available in the internet under www.twk.de

File name of the GSD file: GSDML-V2.25-TWK-CRT-20120229.xml (The version and date may vary depending on the status of the GSD file.)

File name of the bitmap: GSDML-0159-1000-TWK_CRT.bmp

Project planning using the example of Step7 is explained in the following chapter.

4. Project planning with Simatic Step7

This chapter explains the procedure for integrating the TWK CRT absolute encoder into the PROFINET network of a Siemens S7 control system. The documentation is based on Step7 version 5.5.

4.1 Prerequisites

You have created a hardware configuration in accordance with your control system structure and a PROFINET sub-network.

This is shown here using the example of a CPU314C:

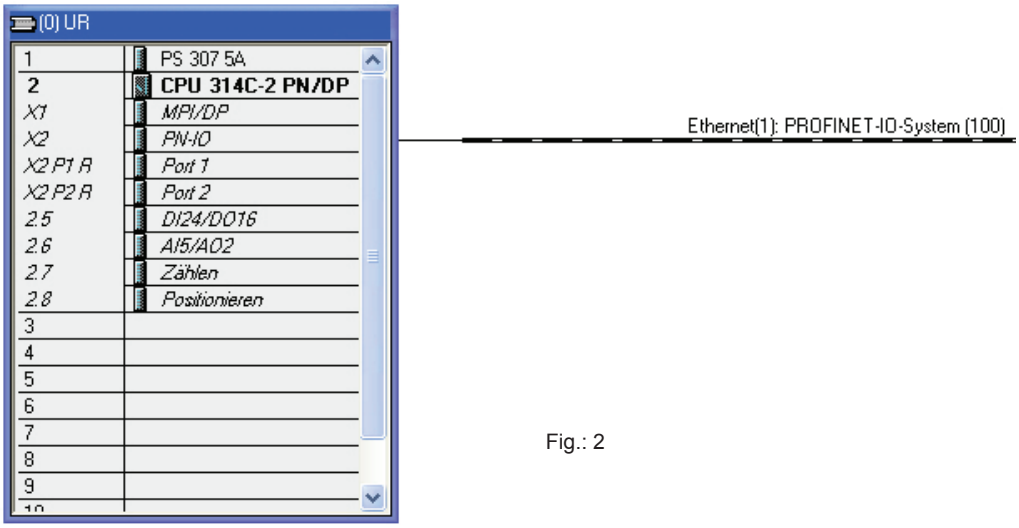


Fig.: 2

4.2 Installation of the GSD file

- Under Extras in the hardware configuration, select **Install GSD files**.
- Set "from the directory", "browse" to your GSD file and click on "Install" (see Figure 3).
- The absolute encoder symbol is also installed automatically.

Note: The GSD file and the encoder symbol are available for download under www.twk.de.

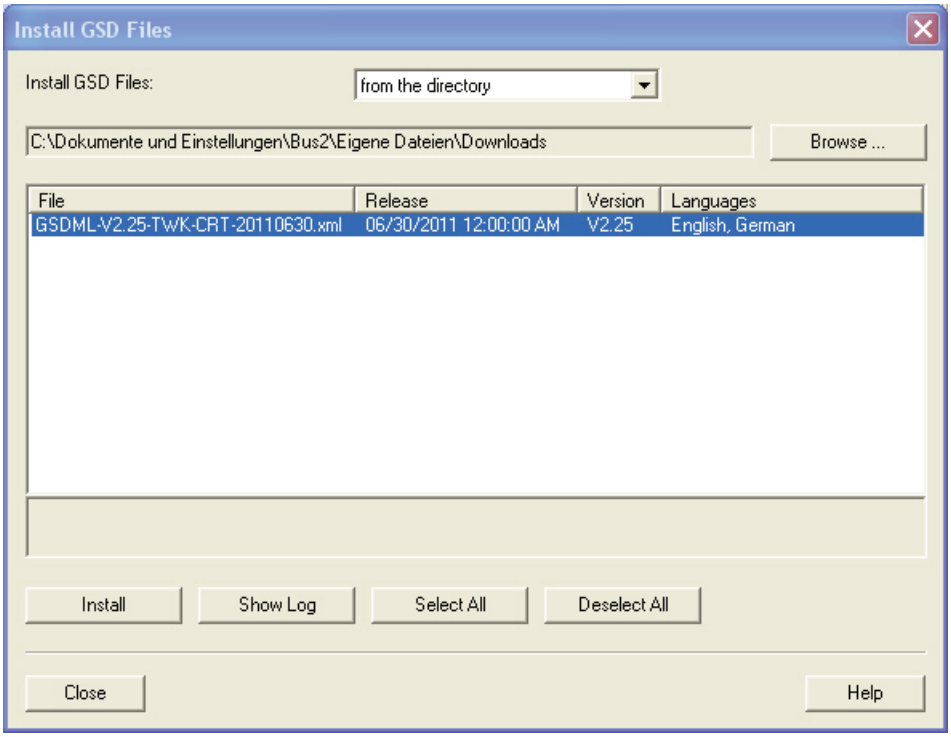


Fig.: 3

After installing the GSD file, the hardware catalogue is automatically updated. The CRT absolute encoder is located under **PROFINET, Further FIELD DEVICES, Encoders, TWK C series, CRT**.

Fig.: 4

4.3 Installing the absolute encoder

Now drag the CRT absolute encoder onto your PROFINET system using the mouse.

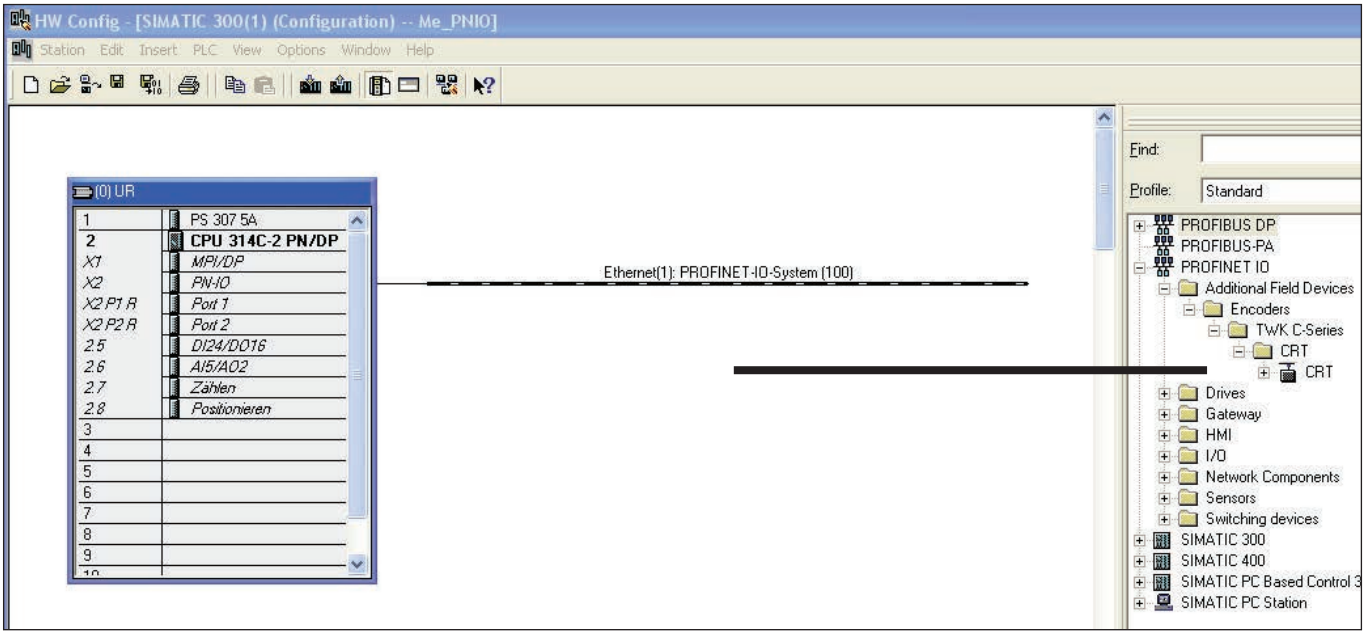


Fig.: 5

The absolute encoder's PROFINET interface is then installed together with its default values. The module corresponding to the absolute encoder then has to be installed.

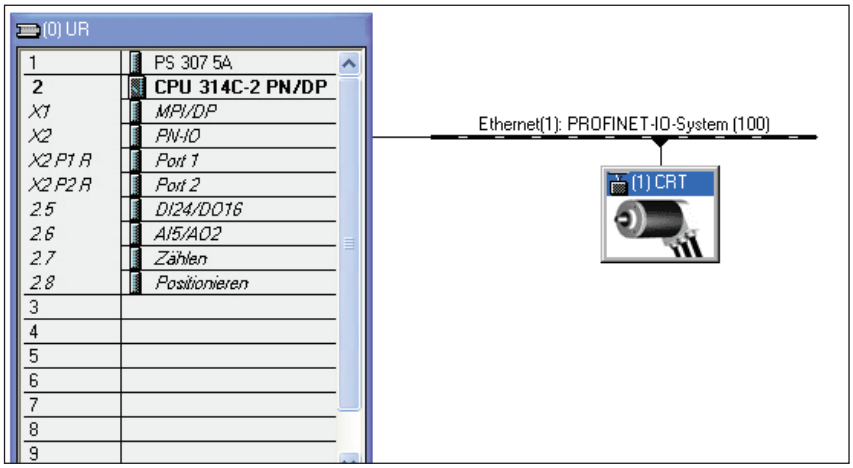


Fig.: 6

4.4 Installing the module

For the encoder type of CRT there are four modules implemented. The modules have a total measuring range of 24 and 25 bit. They are with and without velocity signal. All four modules are realized to encoder class 2 profile. The following table shows which module can be used for which encoder.

Article number	Module	Remarks
CRTxx-4096R4096C4M01	Class2, 24 bit	
	Class2, position (24 bit) + velocity	Firmware version ≥ 2.0
CRTxx-8192R4096C4M01	Class2, 25 bit	
	Class2, position (25 bit) + velocity	Firmware version ≥ 2.0

Now drag the module corresponding to your absolute encoder to slot one in the module list using the mouse.

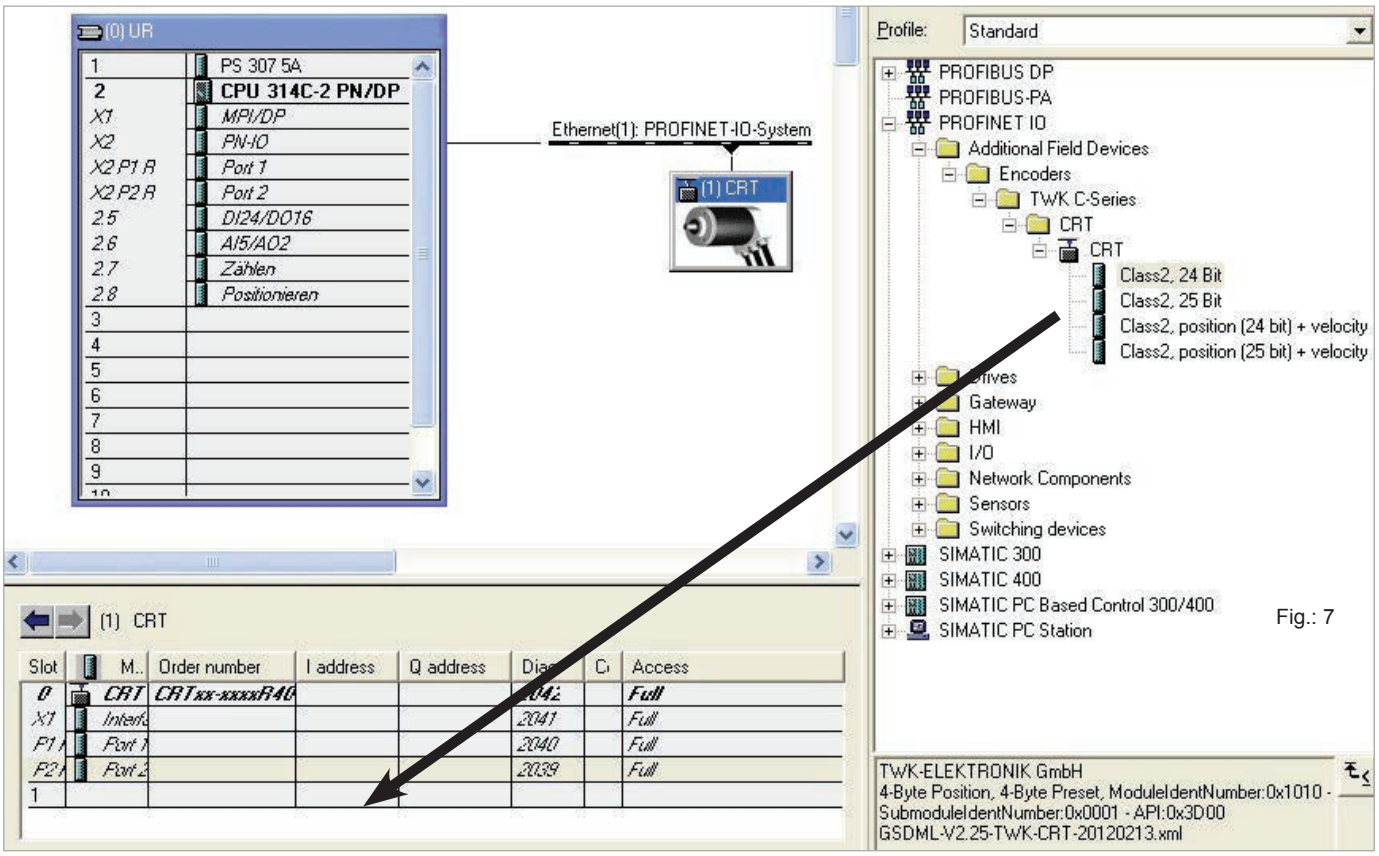


Fig.: 7

The network data can be set by double-clicking onto the absolute encoder symbol (see Chapter 4.5), and the I/O address plus the absolute encoder parameters can be set by double-clicking onto the line "Slot 1" (see Chapter 4.6).

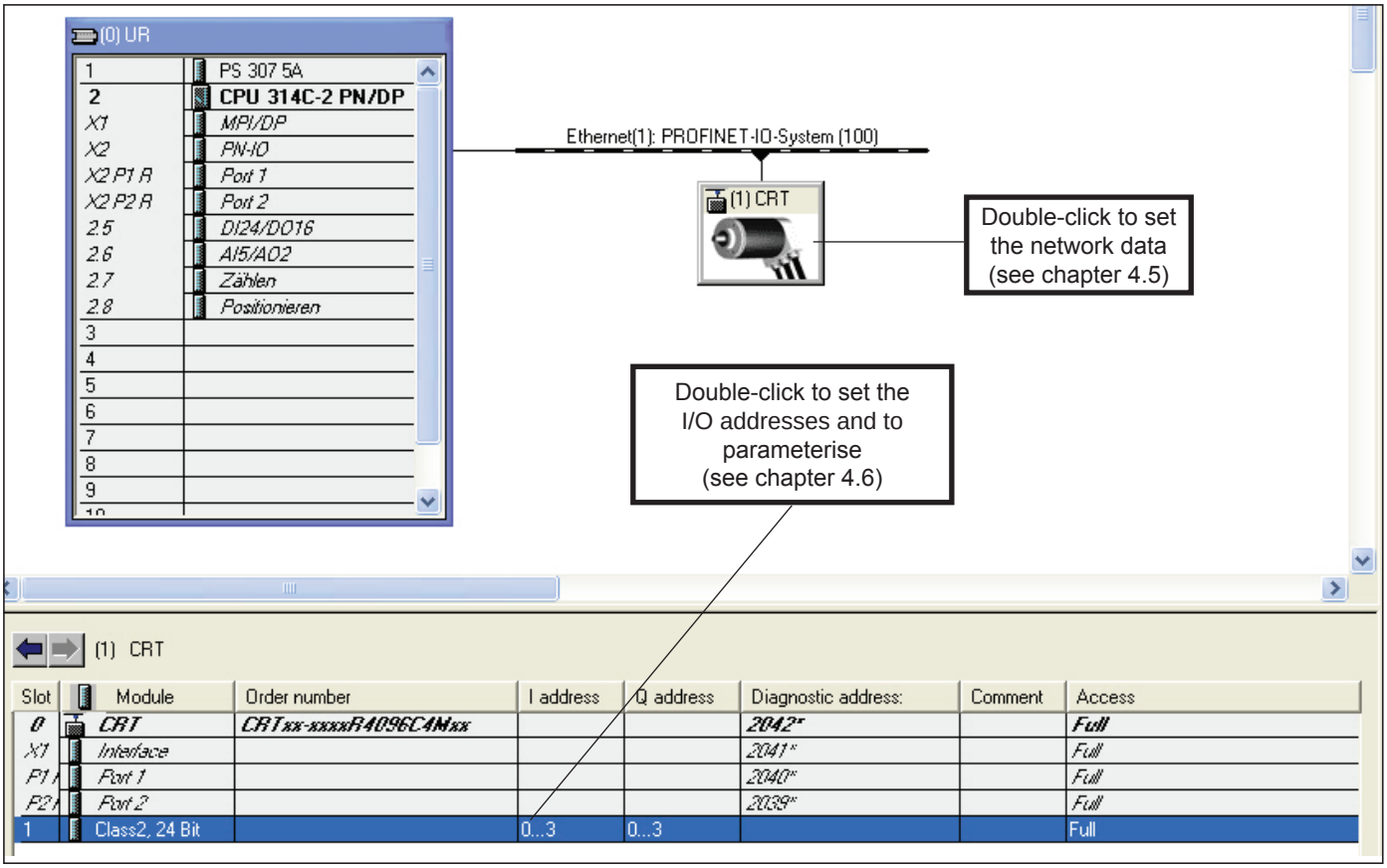


Fig.: 8

4.5 Setting the network data (CRT properties)

The following dialogue appears by double-clicking onto the absolute encoder symbol (or via the absolute encoder's context menu). Enter a name which is unique throughout the network to identify the device here. The controller expects this name when the device logs in. The default name is CRT. If only one TWK absolute encoder is contained in the network, this name can be retained.

The name assigned here must either be manually allocated to the absolute encoder (see Chapter 4.9) or it can be assigned automatically by the controller using the topology editor (see Chapter 4.8 Planning of "Device exchange without programming device" and "Automatic commissioning").

The device name is stored in the absolute encoder, where it is protected against zero voltage. An installed device can be exchanged with a mint condition device without a programming device or exchanging a memory card. The correct name is automatically assigned to the new absolute encoder by the controller. To do this, however, the prerequisites under Chapter 4.8 have to be met.

If the tick in front of "IP address assignment by IO controller" is set, the controller automatically assigns an IP address to the device which contacts it with this name. Manually setting an address as is usual in the case of previous field bus systems is not necessary.

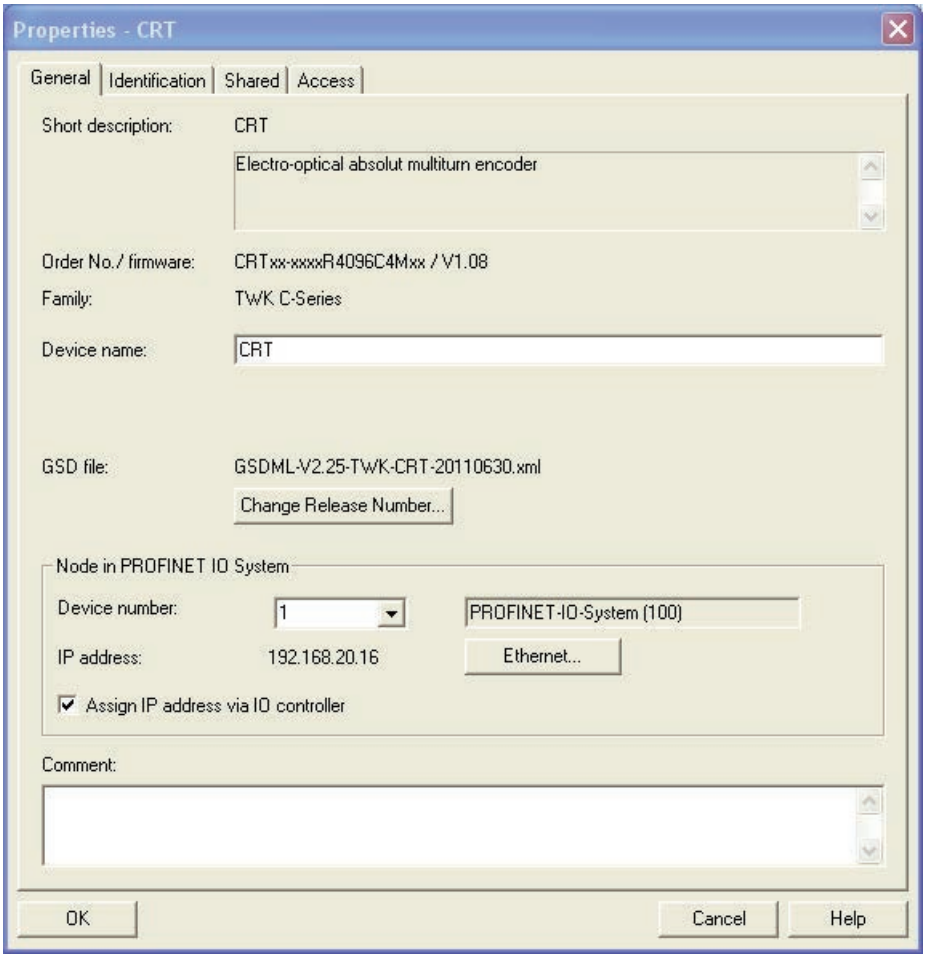


Fig.: 9

System and location codes can be specified for the absolute encoder in the "Identification" tab. These are stored in the S7 project.

The "Shared" tab offers the option of generating a "Shared device" which is simultaneously used by two or more IO controllers.

If the absolute encoder is operated as a "shared device", the various IO controllers' access to the absolute encoder can be set in the "Access" tab.

4.6 Setting the absolute encoder (properties of the module)

4.6.1 Setting the I/O address

The dialogues for setting the I/O address and for setting the absolute encoder parameters can be accessed by double-clicking the installed module (slot 1 line) or via the module's context menu.

Set the input address for the position value respectivly position and velocity value and the output address for the preset value in the "Addresses" tab. (See Chapter 5 for the data format) The following figure shows the addresses tab for the module "Class2, 24 bit".

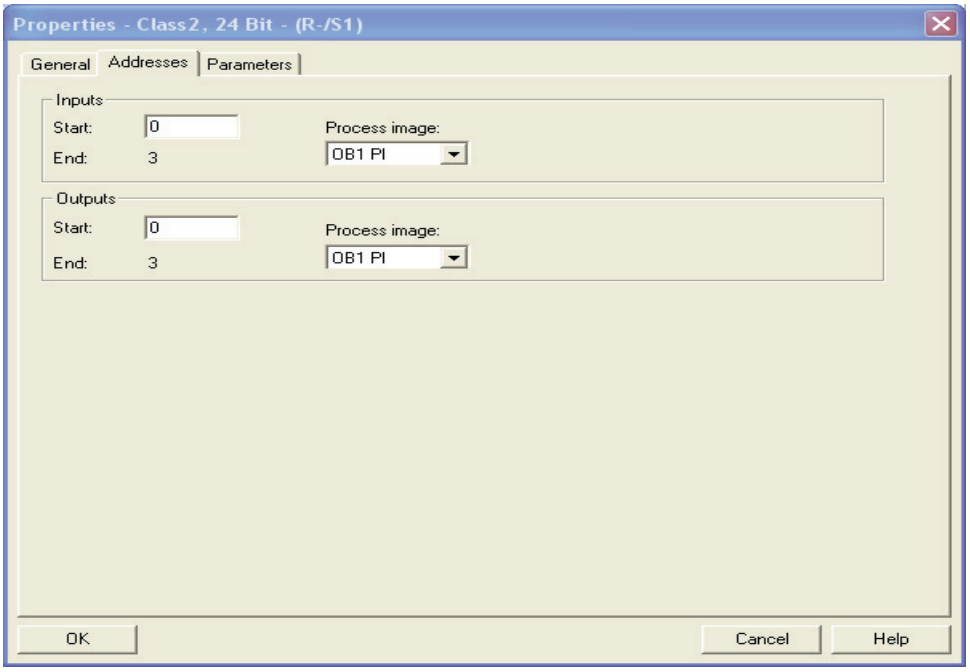


Fig.: 10

4.6.2 Parameterising the absolute encoder

The absolute encoder's parameters can be changed in the "Parameters" tab. An explanation of the parameters can be found in Chapter 6. The following figure shows the parameters tab for the module "Class2, 24 bit".

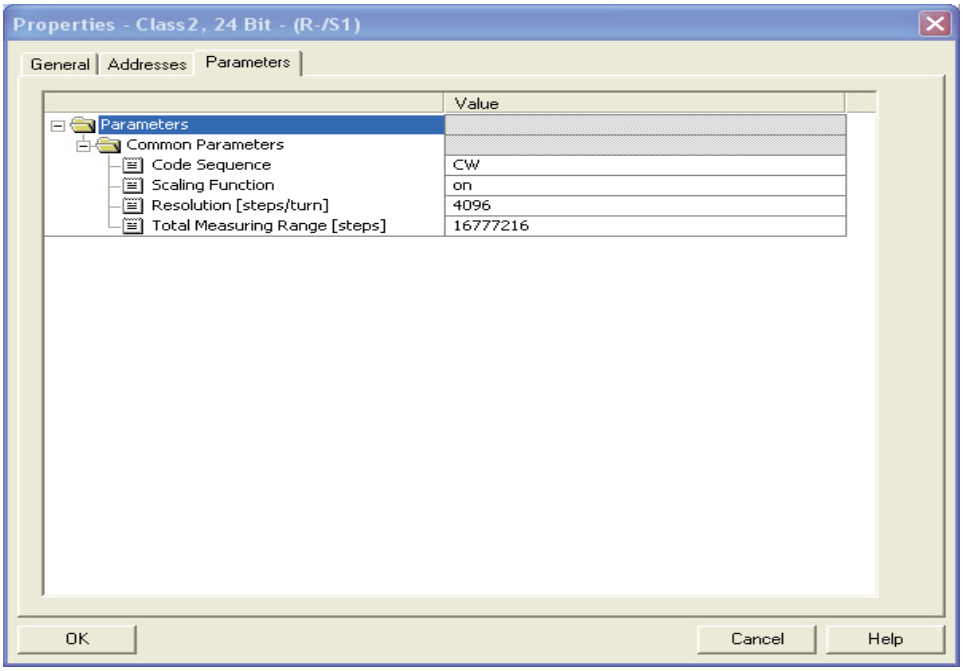


Fig.: 11

4.7 Setting real time mode and the updating time

The following dialogues are accessed via the PROFINET system's context menu:

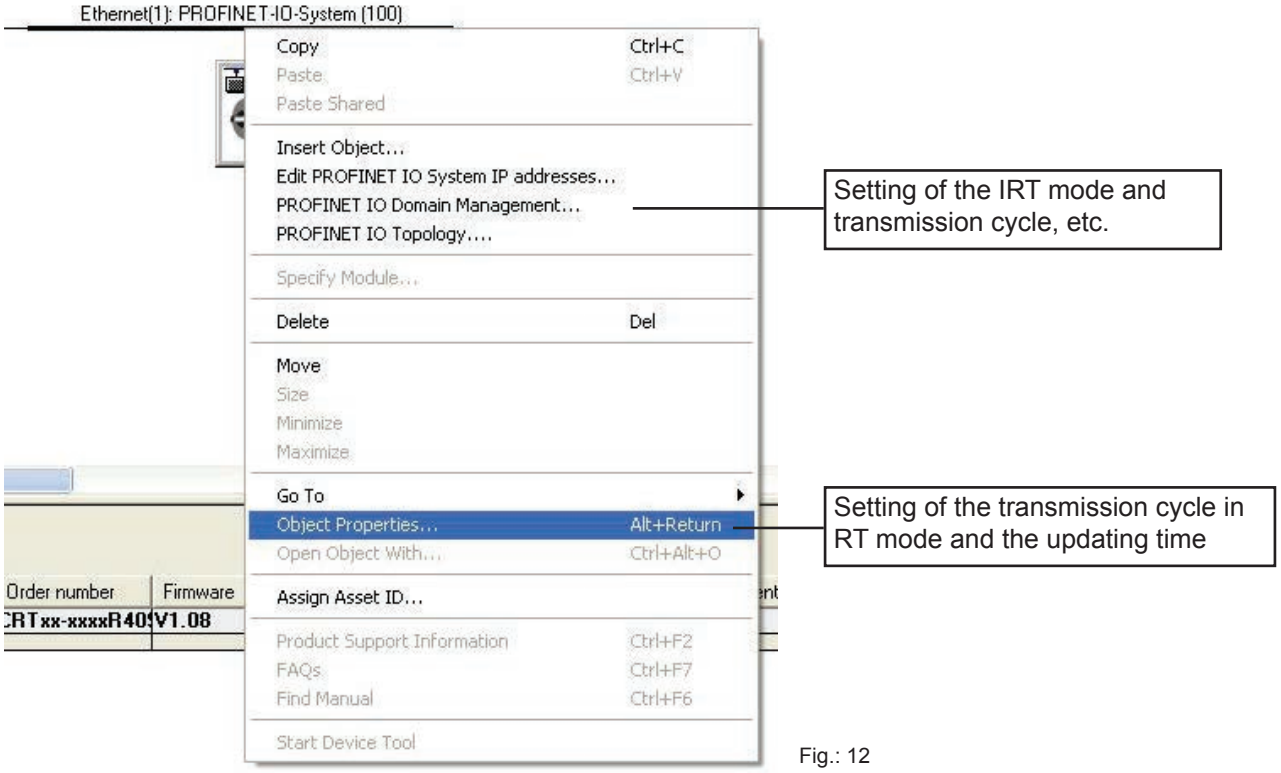


Fig.: 12

Set the transmission cycle and the desired updating time in the corresponding dialogue. Alternatively, the updating time can also be set via the interface's object properties. The default value is 2 ms for the updating time and 1 ms for the transmission cycle. The minimum updating time for the CRT is 0.5 ms.

4.8 Planning of "Device exchange without programming device" and "Automatic commissioning"

If system restarting without the assignment of a new device name or the IP address is to be possible following the exchange of an installed absolute encoder with a mint condition device, this must be taken into consideration during project planning. This also applies to "Automatic commissioning", in which the manual and, in the case of larger projects, time-consuming assignment of the device name (as described in Chapter 4.9) is avoided during commissioning.

The following prerequisites have to be met:

- The controller and the devices must support the function "Device exchange without interchangeable medium or programming device" (for the latter, at least the device itself and its neighbouring devices). The CRT supports this function.
- The function "Device exchange without interchangeable medium" must be activated in the controller. This is the default setting.
- The devices must be in delivery condition, i.e. they must not yet possess any device name.

Now call the topology editor using the PROFINET system's context menu (see Fig. 12) and define all PROFINET connections between the subscribers.

If the project is now loaded into the control system and the actual structure corresponds to the planned topology, all subscribers receive their planned names from the controller and device exchange succeeds without the reassignment of the device name.

4.9 Assignment of the device name

If a PROFINET topology has not been defined as described in Chapter 4.8 or if the prerequisites for automatic commissioning are not met, the absolute encoder name must be assigned manually.

With the absolute encoder connected and the programming device connected to the control system, select "Target system -> Edit Ethernet subscribers" in the Simatic Manager to do this. Press the "Browse" button in the subsequent dialogue. All accessible PROFINET subscribers should now be shown as portrayed in the example in Figure 13.

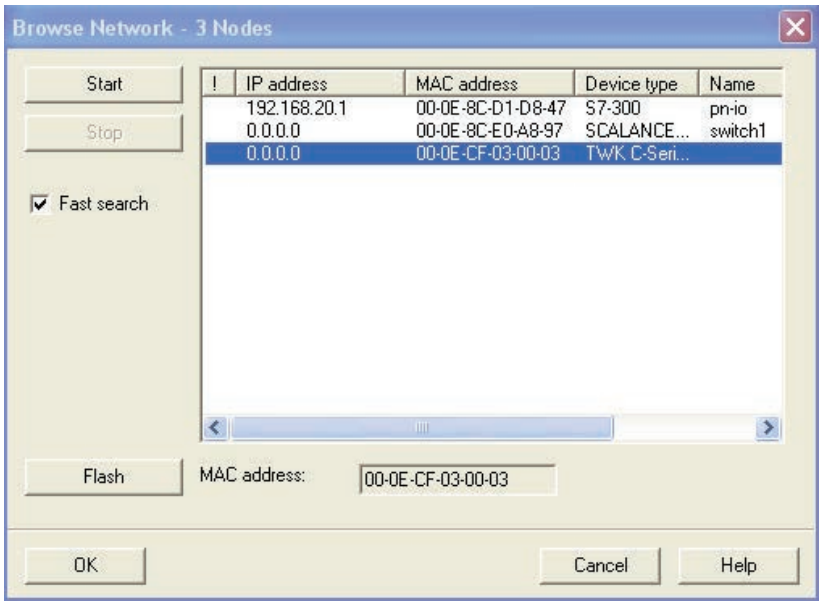


Fig.: 13

It can be seen that the absolute encoder device type "TWK C series" does not possess either a valid IP address or a name. Now mark the absolute encoder and exit the dialogue with OK.

In the subsequent dialogue, enter a device name (the default setting is "CRT") and click onto the "Assign name" button. The device name is then stored in the absolute encoder, where it is protected against zero voltage.

The absolute encoder now logs onto the controller with its device name and is then provided with a valid IP address by the controller. This is also stored in the absolute encoder, where it is protected against zero voltage.

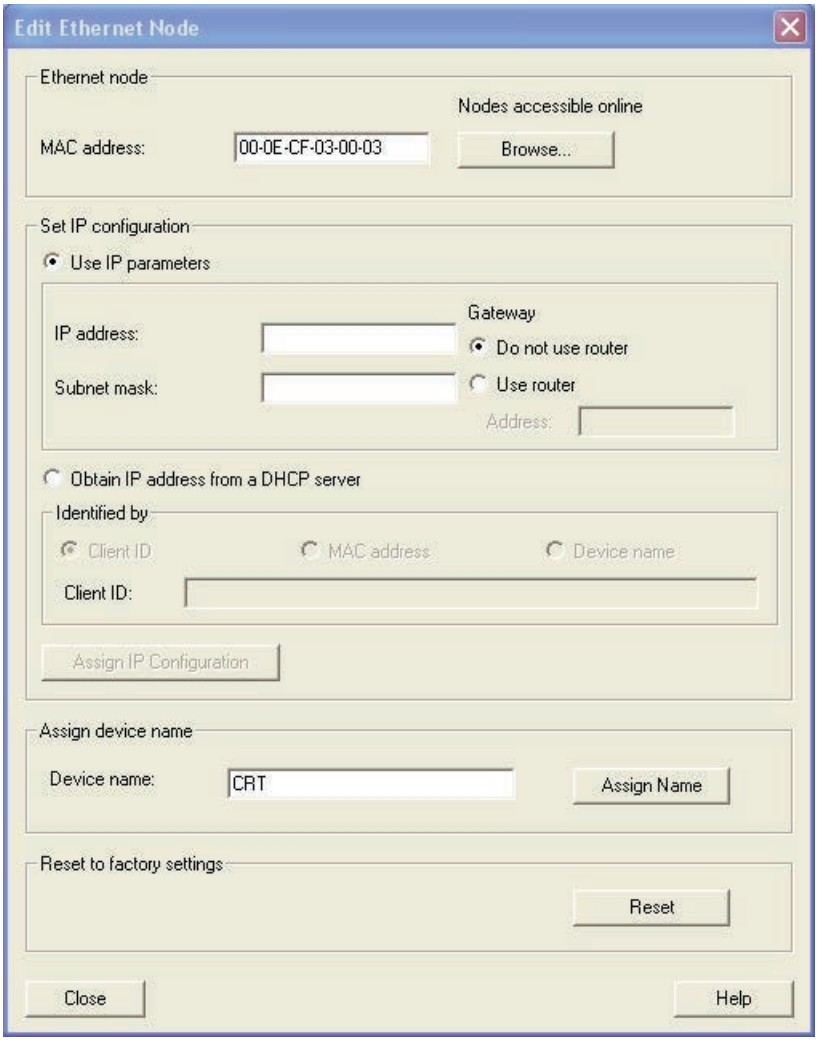


Fig.: 14

4.10 Resetting to the default settings

The absolute encoder can be reset to its delivery condition using the "Reset" button in the "Edit Ethernet subscribers" dialogue (Figure 14).

The following are reset	Delivery condition
Parameters	See Chapter 6.2 for default values
Offset	0 (i.e. the preset setting is undone)
Device name	Empty
IP-parameters	All 0
I&M0-revision counter	0

After resetting, the connection to the profinet controller is closed and the NS LED lights up red.
After switching the voltage off/on, the connection can be re-established by assigning the device name.

If the connections have been defined using the topology editor, the CRT restarts automatically with the name assigned during project planning.

4.11 Application programme

All of the program modules in the following examples can be found in the internet under www.twk.de.

Note: **TWK-ELEKTRONIK GmbH provides no guarantee for the correct functioning of the example programmes shown here!**

4.11.1 Position value and preset

Once the absolute encoder has started up on the PROFINET, the absolute encoder's position value can be read-in as a double word and the preset can be set as a double word under the input address assigned in Chapter 4.6.1. (See Chapter 5 for the data format).

In the following example, bytes 0 to 3 have been selected as the absolute encoder's I/O address.

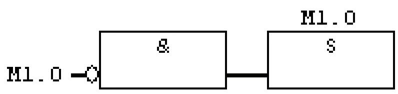
OB 1: Display position value and set preset

OB1 : "Main Program Sweep (Cycle)"

Comment:

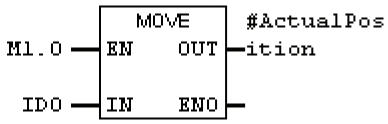
Network 1 : Generate one flag

Comment:



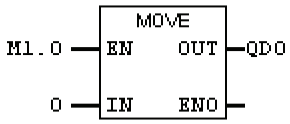
Network 2 : Read actual CRT position

Comment:



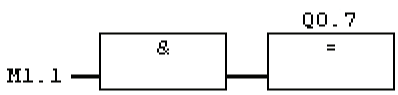
Network 3 : Load preset value (0 here)

Comment:



Network 4 : Set preset bit

Comment:



4.11.2 Reading diagnostic data

On occurrence of a PROFINET device diagnostic alarm, OB 82 is run through in S7. Amongst other aspects, the trigger for the diagnostic alarm can be ascertained in this. The diagnostic data can then be read-out with SFB52.

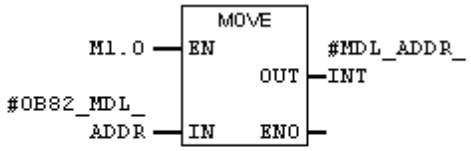
The events which trigger a diagnostic alarm in the absolute encoder can be found in Chapter 7.2.

The following example shows how this can be implemented in Step7. The absolute encoder again has the I/O address (logical basic address) 0 in this case. The control system transfers the logical basic address of the device which has transmitted the diagnostic alarm in the local variable #OB82_MDL_ADDR.

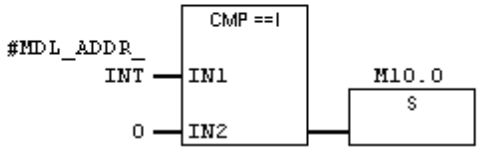
Note: In addition to the diagnostic data, the other data records listed in Chapter 7 can also be read-out with SFB 52.

OB 82: Evaluation of the local OB 82 data and initialisation of the read job

```
OB82 : Title:
OB82 is run through as soon as an assembly/module submits a diagnostic request
or sends an alarm
Network 1: Conversion to integer format
Comment:
```

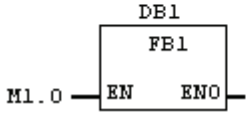



```
Network 2 : Set diagnostic requirement
Absolute encoder with logical basic address 0
```



OB 1: Calling the FB 1 to read the diagnostic data

```
Network 5 : Read data record with SFB52
Comment:
```



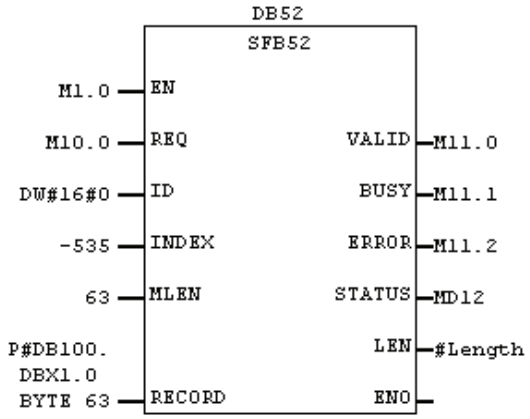
FB 1: Reading the diagnostic data with the SFB52 RDREC

FB1 : Diagnostic data read

The data are stored in DB100 as of byte 1.

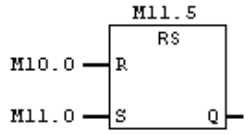
Network 1: Call SFB52 (RDREC)

ID = record index
Here: -535 dec. = FDE9 hex. - encoder diagnostic data record (63 bytes)



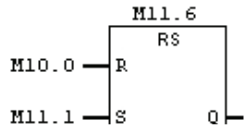
Network 2 : Data valid

Indicates whether the last read process was successful and the data are valid



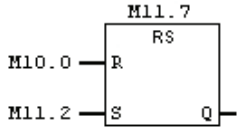
Network 3 : Busy

Indicates whether the last read process was initialised



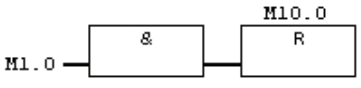
Network 4 : Error

Indicates whether the last read process was incorrect.



Network 5 : Reset diagnostic requirement

Comment:



4.11.3 Writing parameters

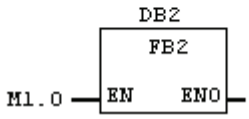
On starting the PROFINET, the parameters set in the hardware configuration are transferred to the CRT and are stored in the absolute encoder's flash memory. However, the S7 user programme enables these to be changed during operation. Each change also leads to storage in the flash memory. Note the following when changing the parameters from the user programme.

Attention! The new parameters are immediately valid!
This function must not be executed without extensive tests during system or machine operation.

OB1: Calling FB2 for writing the parameter data

Network 6 : Write data record with SFB53

```
Comment:
```



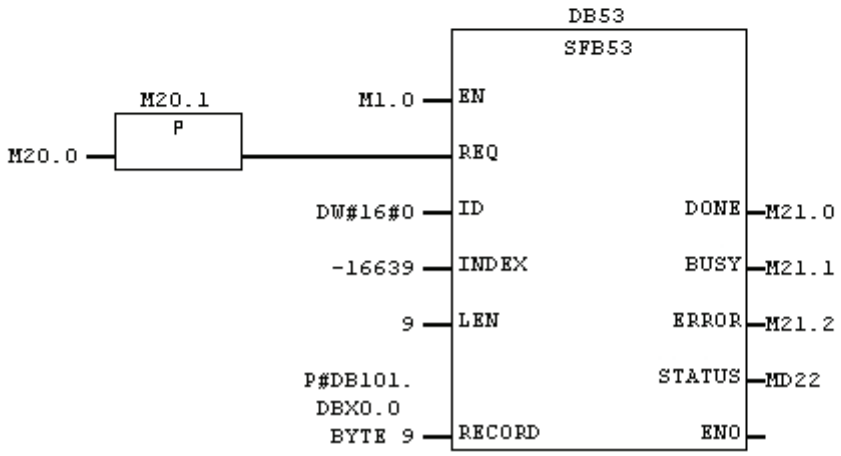
FB2: Writing the data record with the SFB53 WRREC

FB2 : Write data record

```
Writes parameter data to the CRT

ATTENTION!!!
The new parameters are immediately valid.
This function must not be executed without extensive tests during system or
machine operation.
```

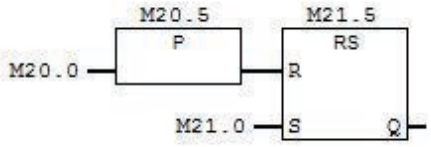
Network 1 : Call SFB53 (WRREC)

```
ID: Initial address of the I address range of the desired encoder

Index - data record number (record index):
BF01 = -16,639 dec. (9 bytes) - parameter data

LEN - length of the data to be transferred

Record - source DB of the data
```



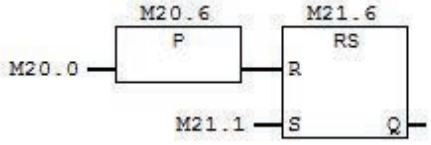
Network 2 : Valid

Indicates whether the last write process was successfull



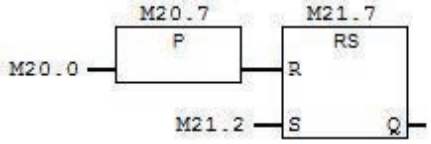
Network 3 : Busy

Indicates whether the last write process was initialised.



Network 4 : Error

Indicates whether the last write process was incorrect.



5. Data format

5.1 Module "Class2, xx bit"

Input data: Device -> Controler

Octet 1	Octet 2	Octet 3	Octet 4
MSB	position data		LSB

Ausgangsdaten: Controler -> Device

Octet 1	Octet 2	Octet 3	Octet 4
MSB	preset data		LSB

5.2 Module "Class2, position (xx bit) + velocity"

Input data: Device -> Controler

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6
MSB	position data		LSB	MSB velocity	LSB

Output data: Controler -> Device

Octet 1	Octet 2	Octet 3	Octet 4
MSB	preset data		LSB

5.3 Position data

The position value is output as a 32-bit unsigned integer value in Motorola format (Big Endian).

Octet 1								Octet 2								Octet 3								Octet 4							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	25-bit position data CRTxx-8192R4096C4Zxx																								
0	0	0	0	0	0	0	0	24-bit position data CRTxx-4096R4096C4Zxx																							

5.4 Velocity

The velocity value is determined via the cyclically read-in of the position data. The dimension is steps per gating time. The gating time (time interval for determining the change of position) is adjustable in the range of 10 - 10000 ms. The default value is 10 ms.

Octet 5								Octet 6							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16 bit velocity															

The speed value is output as a 16-bit signed integer value in Motorola format (Big-Endian). The following applies to the prefix:

positive for increasing position
negative for decreasing position

The refresh rate of the velocity signal is independent from the selected gating time always 10 ms.

The speed measurement resolution is independent of the resolution set for the position value (resolution parameter). It is always based on a resolution of 4096 steps per revolution.

The steps/gating time unit can be converted to rpm as follows:

$$u = \frac{v \times 60000 / t}{4096}$$

v = encoder output for speed value
t = gating time in ms
u = speed in rpm

5.5 Setting the reference value (preset value)

The set reference value (preset value) function should only be executed whilst the absolute encoder shaft is stationary!

In certain cases, setting the reference value is unavoidable in order to compare the machine position values and the absolute position of the absolute encoder. The reference value is the position value which is displayed at the reference point. The user must note that the reference value must lie within the range of 0 to (total number of steps - 1). This particularly has to be taken into consideration when changing the total number of steps. In cyclical I/O data traffic, the reference value is transferred by setting bit 31 (octet 1, bit 7) of the output byte with the lowest value.

Setting the reference value is only possible when scaling is switched on (see Chapter 6)!

Octet 1								Octet 2								Octet 3								Octet 4							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0/1	0	0	0	0	0	0	25 bit preset value CRTxx-8192R4096C4Zxx																								
0/1	0	0	0	0	0	0	0	24 bit preset value CRTxx-4096R4096C4Zxx																							

As in the case of the position value, the preset value is coded as a 32-bit unsigned integer in Motorola format (Big Endian).

The preset value is taken over with the ascending flank of bit 31. An offset value is calculated (from the current actual position value and the reference value) by the absolute encoder in this case. This is stored in the absolute encoder, where it is protected against zero voltage, with the result that the new position is correctly output again even following voltage failure.

If the output actual position value is equal to the reference value, resetting can be carried out using bit 31, as preset mode is ended.

On inputting an incorrect preset value, control bit 31 has to be set to zero before inputting the correct preset value in order to rectify the error. The preset value can therefore be reset by setting control bit 31 to 1.

6. Parameterisation

Parameterisation of the absolute encoder is carried out using the acyclical PROFINET services. In the case of the Simatic S7 control system, this is carried out during starting as default, but can also be carried out during I/O data traffic via the user programme.

Attention: Never change the parameterisation whilst a system or machine is in operation!

The data record number (record index) of the parameter data is: 0xBF01.

6.1 Overview

Byte	Data type	Designation	Default
1	BYTE	Operating mode	0x08
2 - 5	UINT32	Single turn resolution [steps/turn]	4096 (8192)
6 - 9	UINT32	Total measuring steps [steps]	16.777.216 (33.554.432)
10 - 11	INT16	Gating time [ms]	10

The values in brackets represent the absolute encoders with 25-bit total number of steps (CRTxx-8192R4096C4Zxx).

6.2 Description of the absolute encoder parameters

Byte	Bit No.	Parameter	Value range	Default	Remark
1	0	Code path	0: clockwise (cw) 1: counter clockwise (ccw)	clockwise (cw)	Ascending values on rotation clockwise (CW) or counter clockwise (CCW). (When looking towards the shaft)
	1-2	Not used			
	3	Scaling function	0: off 1: on	on	The reference value and parameters are only taken over or become active with "on".
	4-7	Not used			
2 - 5		Resolution [steps/revolution]	1 - 4096 (8192)	4096 (8192)	To change this, the parameter "Scaling function" must be set to "on"
6 - 9		Total number of steps [steps]	1 - 16,777,216 (33,554,432)	16,777,216 (33,554,432)	To change this, the parameter "Scaling function" must be set to "on"
10 - 11		Gating time [ms]	10 - 10000	10	Only for module "Class2, position (xx bit) + velocity" (from firmware version 2.0 on)

Notes:

Coding:

All values in Motorola format (Big Endian)

Total number of steps:

It must be noted that the number of revolutions is calculated in powers of 2n internally in the encoder. Irrespective of this requirement, the user can programme the desired total number of steps and the desired resolution according to the application. During calculation, the absolute encoder uses the next highest power of 2n if necessary. In this case, the values are designated as the effective resolution or the effective total number of steps and are displayed as the output values.

Parameterisation

Example :	Desired total number of steps:	20,480
	Desired resolution:	4096
	Desired number of revolutions:	5
	Internal absolute encoder calculation	
	Effective total number of steps:	32,768
	Effective resolution:	4096
	Calculated number of revolutions:	8

(Note: The above notice is to be taken into consideration in the case of non-reversible operation. In the listed example, position 0 is only reached after 32,767 steps and not after 20,479 steps as desired.)

7. Diagnosis

7.1 Overview

The data records listed in the table below are available for diagnosis for the CRT. These can be read-out using the acyclical read services.

Record Index	Data record
0x8028	Input values (from the point of view of the control system), here: position value
0x8029	Output values (from the point of view of the control system), here: preset value
0xAFF0	I&M0 data (according to I&M specifications version 1.2)
0xBF01	Parameter data (see Chapter 6)
0xFDE9	Diagnostic data (see below)

7.2 Diagnostic data

Diagnostic data in data record 0xFDE9					
Byte	**Datatyp**	**Diagnostic function**	**Default** (values in hex)	**Diagnostic alarm**	**Remark**
1 - 8	BYTE	Reserved	00		
9	BYTE	Operating status	08	No	CW, Scaling on
10	BYTE	Encoder typ	01	No	Absolute multiturn encoder
11 - 14	UINT32	Maximum resolution	0000.1000 (0000.2000)	No	4096 (8192) steps/revolution
15 - 16	UINT16	Maximum measuring range	1000	No	4096 revolutions
17	UINT8	Additional alarm messages	00	No	Not supported
18 - 19	UINT16	Supported alarm messages	0000	No	Not supported
20 - 21	UINT16	Warning messages	0000	No	Not supported
22 - 23	UINT16	Supported warning messa-ges	0000	No	Not supported
24 - 25	UINT16	Profile version	0101	No	Current encoder profile version
26 - 27	UINT16	Software version	xx.xx	No	Current firmware version
28 - 31	UINT32	Operating time	FFFF.FFFF	No	Not supported
32 - 35	UINT32	Offset value	0000.0000	No	Current internally calculated offset value
36 - 39	UINT32	Manufacturer offset value	0000.0000	No	Not supported
40 - 43	UINT32	Resolution	0000.1000 (0000.2000)	No	Currently set resolution
44 - 47	UINT32	Total number of steps	01.000.0000 (02.000.0000)	No	Current total number of steps
48 - 57	BYTE	Serial number		No	Serial number of the device
58 - 59	BYTE	Reserved	0000	No	
60 - 63	BYTE	Manufacturer-specific dia-gnostic data	00000000	Yes	See Chapter 7.3

The values in brackets represent the absolute encoders with 25-bit total number of steps (CRTxx-8192R4096C4Zxx).

7.3 Manufacturer-specific diagnostic data

Byte	Bit	Error message	Position value	Red LED	Help
60	0 - 7	Not used			
61	0 - 7	Not used			
62	0	Flash memory error	0	Rapid flashing (10 Hz)	Please repeat parameter value transfer or switch the voltage off/on to restart the rotary encoder. Exchange the device as soon as possible.
	1	Module error	0	Rapid flashing (10 Hz)	The selected module is not supported by the encoders firmware. Please select a different module in your hardware configuration.
	2 - 7	Not used			
63	0 - 1	Not used			
	2	Parameter error	0	Flashing (2 Hz)	The value for the total number of steps must lie in the resolution range ... (resolution x max. number of revolutions (4096)).
	3	Scaling error	Unchanged	Flashing (2 Hz)	Please switch on the scaling function before setting the preset or changing the values for the resolution and total number of steps.
	4	Not used			
	5	Internal error	0	Rapid flashing (10 Hz)	Please repeat parameter value transfer or switch the voltage off/on to restart the rotary encoder.
	6	Preset error	Unchanged	Flashing (2 Hz)	The preset value must lie in the range 0 ... (total number of steps -1).
	7	Velocity range exceede	Unchanged	Flashing (2 Hz)	Please reduce speed or the value for the gating time

8. Scope of delivery

The scope of delivery includes:
- Absolute encoder with PROFINET interface
- Connection assignment TY XXXXX (depending on the device variant)

Available for download on www.twk.de are:
- the corresponding datasheet
- this user manual
- the PNO certificate
- example programmes
- GSD file and bitmap

Annex A: absolute encoder terms

Parameter	Explanation
Resolution - steps/360°	The resolution specifies the number of steps per revolution (360°).
Measuring range	The measuring range specifies the maximum number of revolutions. The revolutions must be specified in powers of 2^n.
Total number of steps	The total number of steps arises as follows: total number of steps = resolution x measuring range
Code path	The code path specifies the direction of rotation in which the encoder's output code ascends. Depending on the direction of rotation, a distinction is made between: CW - clockwise direction of rotation CCW - counter clockwise direction of rotation (when looking towards the shaft)
Reference value/preset	The reference value is the value which appears as the encoder's actual position value according to the preset function. It lies in the value range from 0 to total number of steps -1.